

## LANDFILL LEACHATE TREATMENT USING MOVING BED BIOFILM REACTOR

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### ABSTRACT

*Landfill leachate is the result of rainfall which passes through the dumped waste, the pollutants in the landfill leachate may lead to the contamination of surface and groundwater resources. Sufficient treatment is required for leachate before the disposal. The concentration of high organic content like COD (Chemical Oxygen Demand), Nitrogen and Phosphorous content and settlement of sludge causes major damage to the environment. Hence, the biological treatment with a suspended growth process was carried out in a lab-scale reactor. The recent process, moving-bed biofilm reactor (MBBR) technology was adopted to treat the leachate. The initial characteristics of leachate were analyzed and observed as pH of 8.75, the turbidity of 450NTU, Total suspended solids of 3427 mg/L, BOD of 912mg/L, COD of 4082 mg/L and ammonia nitrogen of 1529 mg/L. The reactor was filled with 25 liters of leachate and biochips were suspended at the upper surface of the leachate. The tank was continuously aerated and the biochips with attached growth were observed. The efficiency of treatment proved the low reduction of COD and less settlement of sludge.*

**KEYWORDS:** *Leachate, MBBR, Biofilm & Biological Treatment*

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### INTRODUCTION

Municipal solid waste (MSW) is a significant environmental problem in many countries. Wastes generated in urban areas are disposed in different ways. Most of the MSW was discard directly into a landfill. Water percolates through the waste generate the leachate. This leachate may cause surface water and groundwater polluted. The leachates contains high concentration organic and inorganic contaminants like ammonia nitrogen, heavy metals, inorganic salts has adverse effect on the environment so it need to be removed.

The high organic matters of landfill leachates and the control of suspended growth activated sludge systems like sparse sludge settle ability and more sludge formation, more the processes like moving-bed bio film bioreactors that advantage from attached-growth is used. Moving-Bed Biofilm Bioreactors (MBBRs) designed for the treatment of landfill leachate biological ammonia nitrogen and chemical oxygen demand (COD) compounds removal through the partial aerobic treatment process.

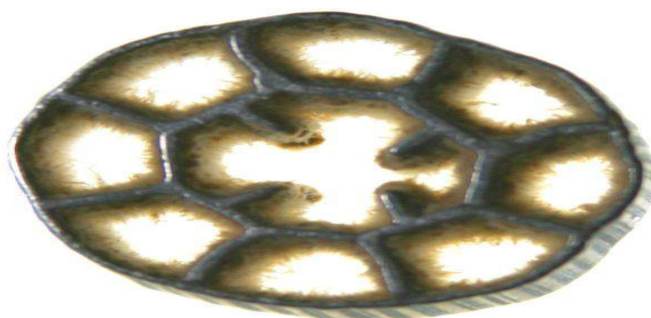
### Characteristic of Leachate

Rainfall is the main source for the production of leachate. The precipitation passes through the dumped solid waste in the landfill the dissolved and suspended elements from the waste through many physical and chemical reactions generate the leachate. Leachate generation includes groundwater inflow, surface water runoff, and biological decomposition. Leachate may contaminate the groundwater and surface water source. The characteristics of the

landfill leachate can usually be represented by the basic parameters pH, COD, BOD, the ratio BOD/COD, total Kjeldahl nitrogen (TKN), ammonium nitrogen ( $\text{NH}_3\text{-N}$ ), heavy metals and suspended solids (SS). Municipal Landfill leachates contain high concentrations of organic content (COD varies from 140 to 15200 mg/L), high amounts of ammonia (varies from 0.2 to 13000 mg/L). Factors affecting the leachates standards are precipitation, type of waste, changes in seasonal weather, age, and formation. The landfill leachates constitution differs due to the age of the landfill.

## MATERIALS AND METHODS

Landfill leachate used in the treatment was acquired from the landfill site of Kumbakonam, Tamil Nadu, India. The total quantity of municipal solid waste collected from the town is 61.09 MT. The leachate which produces from these solid waste is to be treated by using MBBR technology. The physical, chemical and biological parameters of the leachate are determined before the treatment and after the treatment are compared to get the treatment efficiency.



**Figure 1: MBBR Media With Biofilm Attached on the Interior Surfaces.**

Moving Bed Biofilm Reactor (MBBR) have been commonly used to treat both urban and industrial waste water. This technology allows for COD and nitrogen removal rates. MBBR was operated in aerobic phases with freely moving buoyant. Moving Bed bio film Reactor (MBBR) is a successful biological treatment process. It is a thoroughly mixed and steadily operated bio film Reactor. The biomass is grown on the small carrier is made up of polyethylene (HDPE) elements which have a lighter density than water and continue in movement along with leachate in the reactor. The movement in the interior of a reactor was caused by aeration in the reactor. The MBBR possesses have many eminent characteristics such as high COD loading, no sludge bulking problem, and high biomass. Currently, Moving Bed bio film Reactor (MBBR) has conduct rising research interest in the application for removal of biodegradable organic matter. MBBR technology engages the number of polyethylene bio film carriers managing in circular motion within a reactor. Each single bio carrier increases capacity by giving a secured surface area to bear the growth of active biomass within its cells. The movement inside a reactor can be caused by continuous supply of compressed air in a reactor by the aerator. The media in the MBBR tank are made of high-density polyethylene (HDPE) it occupies 30 to 60% of empty tank volume.

### Experimental Setup

Lab scale MBBR tank was fabricated. Leachate was filled in the tank and aerated for a week. A biofilm media made up of polyethylene top up 30% of the tank volume. Initial values of the leachate parameters were analysed before the process of aerobic treatment. With the retention time of 6 days, the samples get analysed for eight weeks. The total operational days was 60 days. Biofilm carrier contains the active biomass degrade the organic matter in the leachate. Due to the biodegradation of organic matter sludge formation is reduced. Continuous aeration provided in the reactor helps in the respiration of active biomass and the movement of biofilm.



Figure 2: Lab Scale MBBR Tank

## RESULTS AND DISCUSSIONS

The operational period of the MBBR tank is 60 days. The physical, chemical and biological parameters of sample collected from different weeks are determined and tabulated. The graph shows the characteristic changes during the treatment in different weeks. In the present study, we treated landfill leachate in a moving-bed biofilm bioreactor under elevated temperature. The characteristics analyzed in this paper are pH, turbidity, total suspended solids (TSS), BOD, COD, and ammonia nitrogen.

Leachate has a pH between 4.5 and 9. The concentration pH profile has the initial value 8.75 and the initial value of 8.75 was decreased up to 8.43 in week 3 and has peak value in week 4 it gets a slightly decrease in week 5 and 6 get decreased to 8.12 in the eighth week shown in figure 3.1 The total suspended solid has the initial value 3427 mg/L shown in fig 3.3 After the aerobic treatment it decreased up to 2718 mg/L. The value of BOD and COD are decreased during the aerobic treatment from 9121 mg/L to 6942 mg/L and 4082 mg/L to 1982 mg/L shown in fig 3.4 and 3.5 respectively. The presence of ammonia nitrogen (N-NH<sub>3</sub>) in initial was 1529 mg/L reduce up to 1245 mg/L during the operational days shown table 1.

Table 1: Parameters Analyzed During the Aerobic Treatment

Sl. No	SAMPLE	pH	TURBIDITY (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	NH <sub>3</sub> -N (mg/L)
1	Initial	8.75	450	3427	9121	4082	1529
2	Week 1	8.54	443	3225	8524	3847	1480
3	Week 2	8.43	437	3179	8238	3288	1425
4	Week 3	8.62	433	2996	7924	3042	1397
5	Week 4	8.95	431	2873	7782	2965	1343
6	Week 5	7.83	429	2658	7538	2516	1312
7	Week 6	7.69	427	2521	7432	2408	1267
8	Week 7	7.92	425	2736	7226	2345	1245
9	Week 8	8.12	428	2718	6942	1982	1224

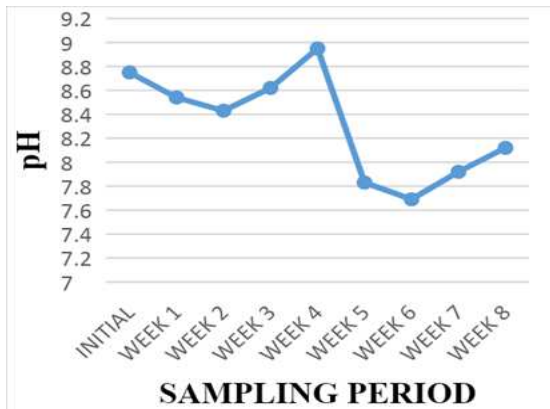


Figure 3: Ph Profile during Aerobic Treatment

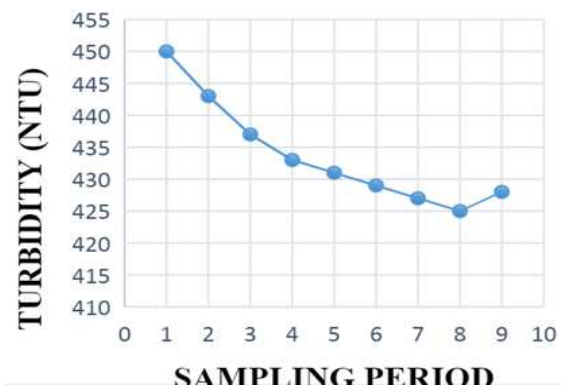


Figure 4: Turbidity during Aerobic Treatment

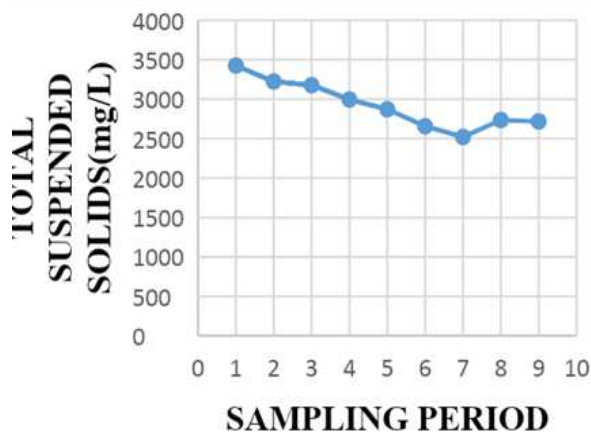


Figure 5: Total Suspended Solids during Aerobic Treatment

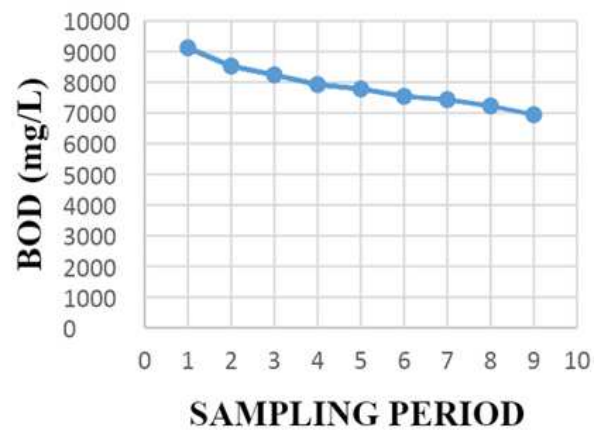


Figure 6: BOD during Aerobic Treatment

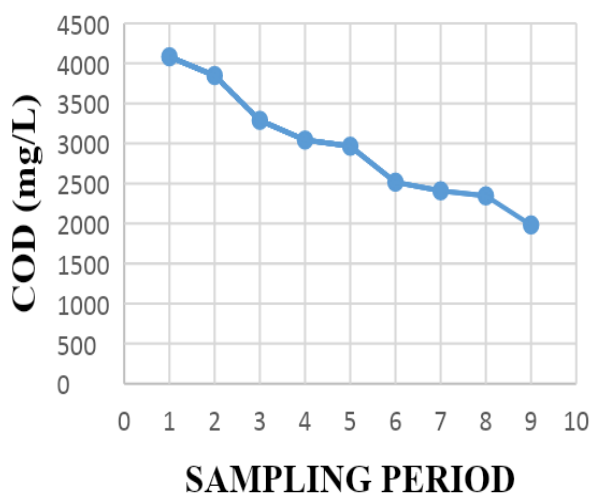


Figure 7: COD during Aerobic Treatment

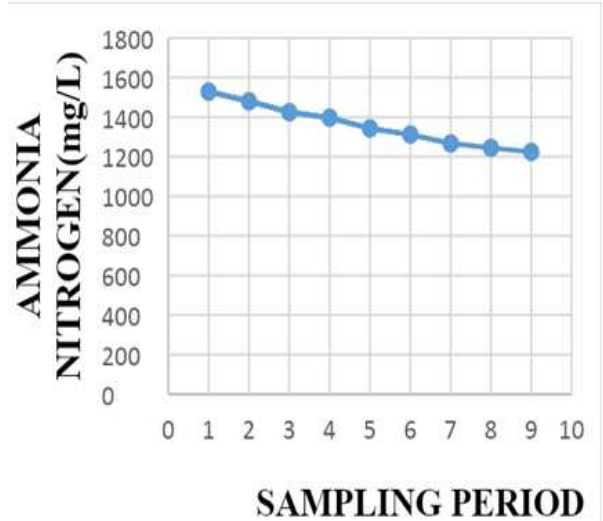


Figure 8: Ammonia Nitrogen during Aerobic Treatment

## CONCLUSIONS

- In the experimental study, landfill leachate was treated by lab scale MBBR technology for 60 days and the retention time of samples was 6 days. Parameters like pH, turbidity, total suspended solids, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Ammonia Nitrogen (N-NH<sub>3</sub>) was analyzed by giving sufficient aeration to the biofilm carrier.
- The concentration of parameters like pH level has the initial value of 8.75 was decreased up to 8.43 in week 3 and has peak value in week 4 it gets a slightly decrease in week 5 and 6.
- The concentration of turbidity has no major changes.
- The total suspended solids were decreased from 3427 mg/L to 2718 mg/L.
- The BOD and COD values also get decreased from 9121 mg/L to 6942 mg/L and 4082 mg/L to 1982 mg/L respectively.
- The presence of ammonia nitrogen (N-NH<sub>3</sub>) in the initial stage was 1529 mg/L reduce up to 1245 mg/L.
- The parameters analyzed in the study are decreased from the initial values. In order to attain the discharge standard values of leachate, the experiment should further be focused on the aeration at different retention time.

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